Fluid Vessel Quantity using Non-Invasive PZT Technology Flight Volume Measurements Under Zero G Analysis

BY: Anthony Garofalo

About Me

- Cocoa Beach
- University of Central Florida
- Mathematics with Engineering and Physics
- Second summer at KSC

My Summer

- Analyzing Data from zero-g parabolic flights.
- Technical Drawings
- Rapid Prototyping
- Making Changes to Schematics
- Welding
- Programming
- Experiments
- Helping with installations
- More

Zero G Flight Data

- 40 parabolic trajectories
- Last 20 seconds
- PZT actuator
- 3 PZT sensors
- 16,384 data points per second

PZT Sensors

- Piezoelectric Sensor
- Sound, vibration and mechanical stress
- Energy Harvesting
- Speakers
- More

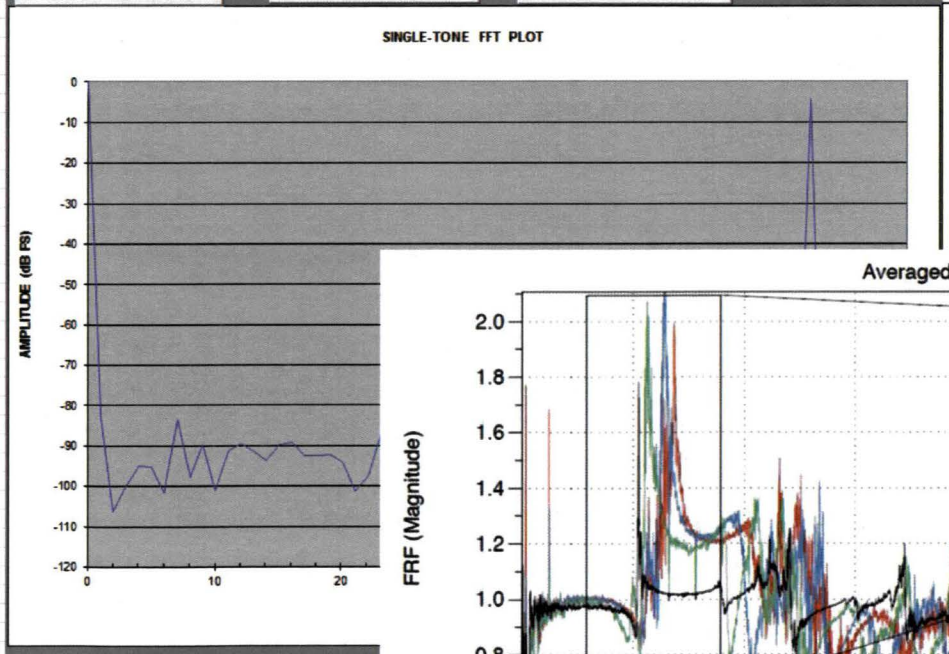
FFT Analysis

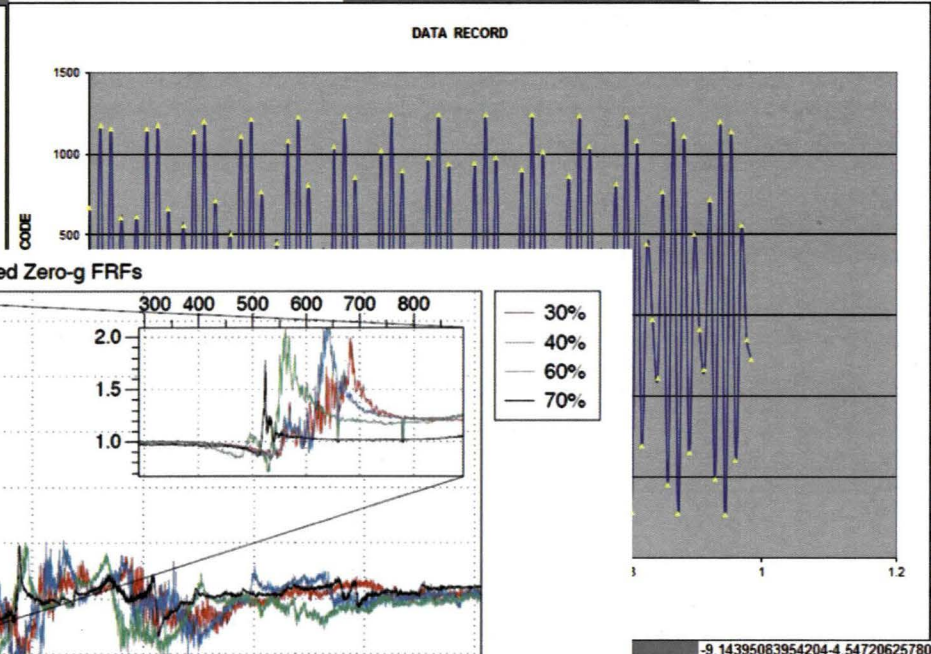
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	ENTER Data Record from ADC	ENTER f_{SAMPLE} (MHz)	ENTER N_{RECORD}	ENTER ADC Resolution (bits)	CALCULATED f_{BIN} (MHz)	CALCULATED $f_{NYQUIST}$ (MHz)	CALCULATED FFT Bin Frequency (MHz)	Calculated # of data point	CALCULATED Time of data point (µs)	CALCULATED Maximum Data Record Point	CALCULATED Minimum Data Record Point	CALCULATED Magnitude of Data Record (dBFS)	FFT CALCULATION Imaginary FFT Points
2	665	129.000064	128	12	1.007813	64.500032	0	0	0.00000	1240	-1240	-4.358165343	4
3	-979						1.007813	1	0.00775				5.18243987691196+7.90111782353419i
4	1178						2.015626	2	0.01550				0.514322033531371-0.388886886612029i
5	-1240						3.023439	3	0.02326				0.408898978367417+1.29149691230704i
6	1156						4.031252	4	0.03101				-0.755962927546105+2.2031515596571i
7	-937						5.039065	5	0.03876				-1.78621976626139+1.4090073086956i
8	609						6.046878	6	0.04651				0.210025112505333+1.08069207581908i
9	-210												2191i
10	-214												8886i
11	613												657i
12	-940												4326i
13	1158												7842i
14	-1240												0629i
15	1177												5981i
16	-976												938i
17	662												88057i
18	-270												654i
19	-154												8352i
20	560												4653i
21	-900												096i
22	1135												851i
23	-1237												121056i
24	1194												0881i
25	-1013												2578i
26	712												59456i
27	-329												4577i
28	-93												901i
29	505												963i
30	-857												82i
31	1109												9807i
32	-1231												2015i
33	1209												032i
34	-1046												
35	761												792i
36	-387												13688i
37	-33												1952i
38	448												4119i
39	-812												055i
40	1080												411i
41	-1222												509i
42	1221												234i
43	-1078												-9.14395083954204-4.54720625780404i
44	808												3.4179879588706+0.940278868798307i
45	-444												0.959316093315744+7.0354693681156i

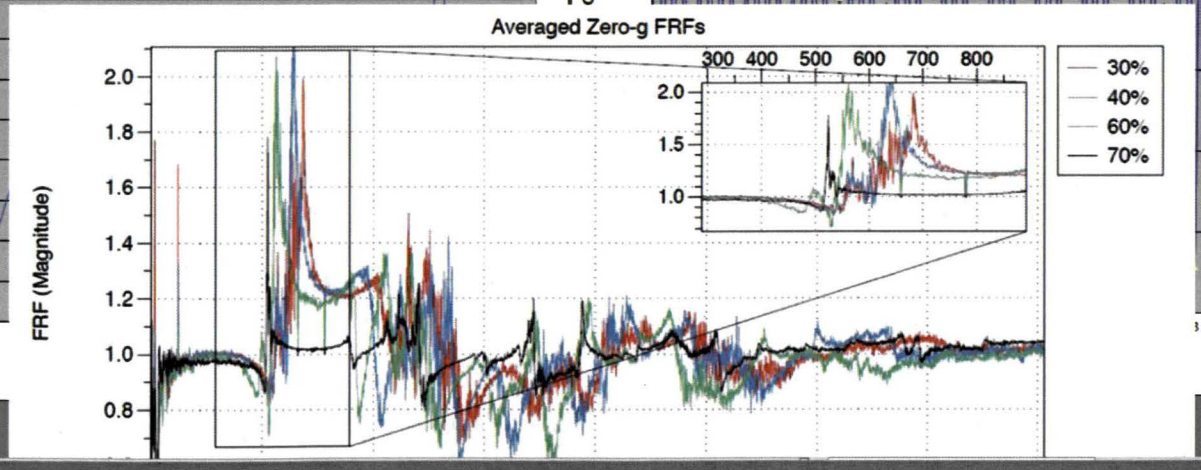
Click Here After Changing fsample | Click Here After Changing Nrecord | Click Here to Crunch FFT

Show_Detailed_Calculations

Hide_Detailed_Calculations

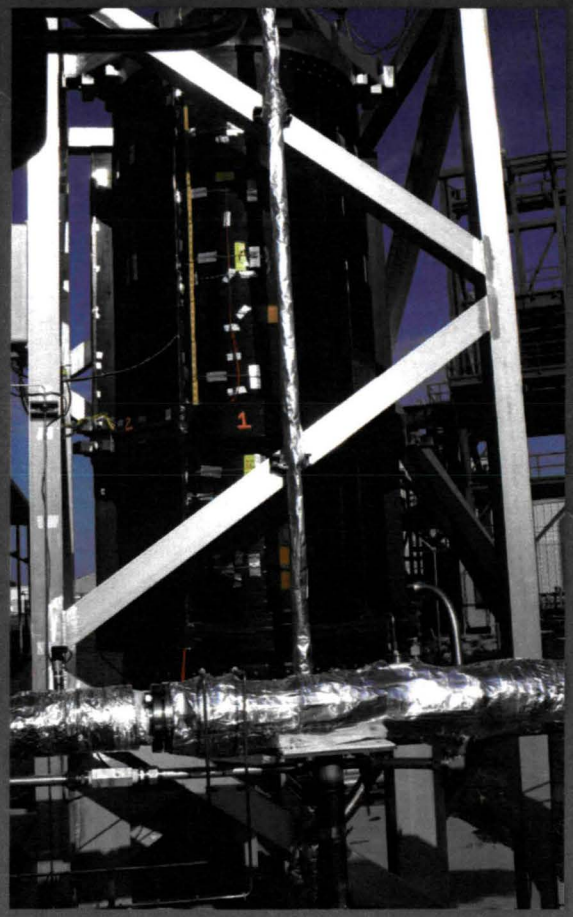






AFRL Composite Tank

Composite Tank with Liquid Nitrogen (KSC Cryogenic Test Lab)

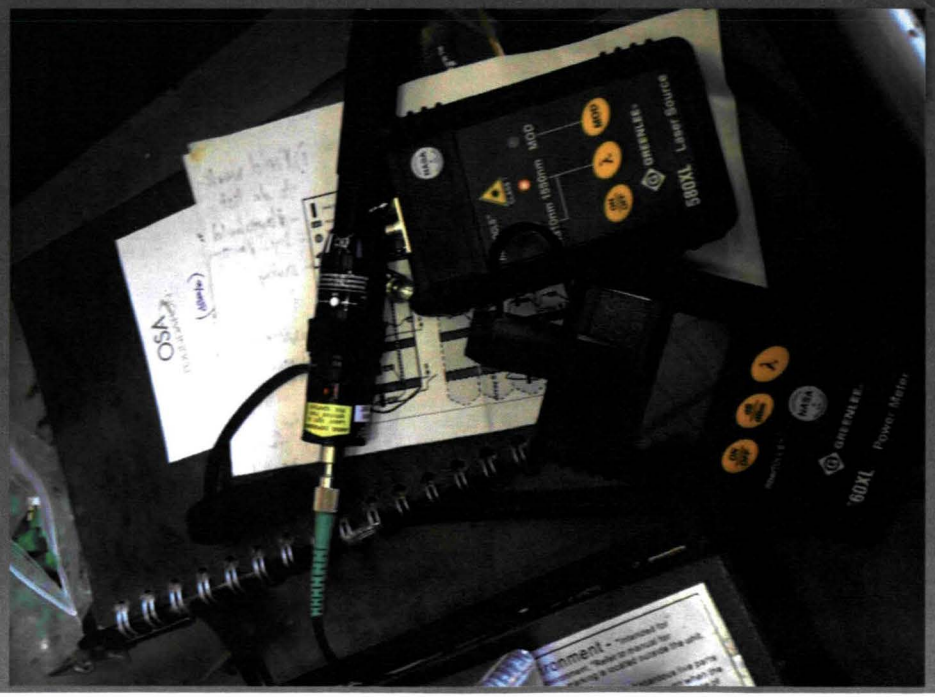


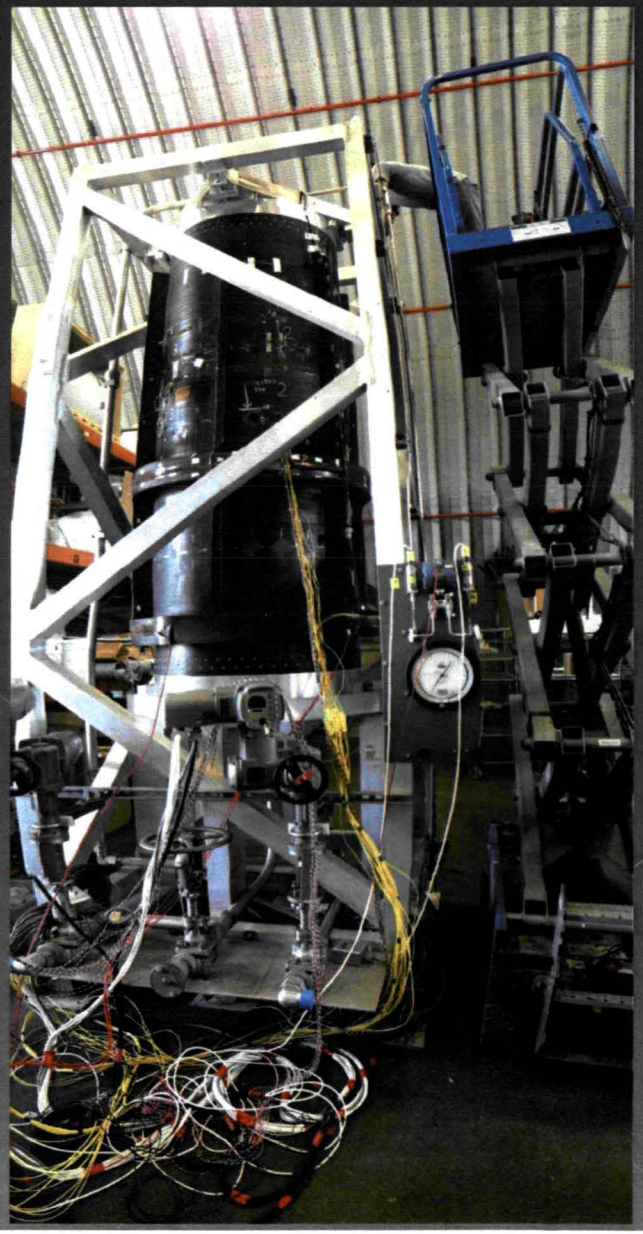
Typical Health Monitoring sensors (non-invasive In Sutu technology)

Health Monitoring Systems	Description
Acoustic Emission	Passive Ultrasonic Mistras
FBG MSFC Optical Strain	high fidelity strain Micron
FBG UCF Optical Strain	high fidelity strain/temperature customized
Smart sensor PZT system	active vibration reflected pulses Acellent
NASA KSC PZT health monitoring System	active vibration modal based frequency analysis

Test Tank

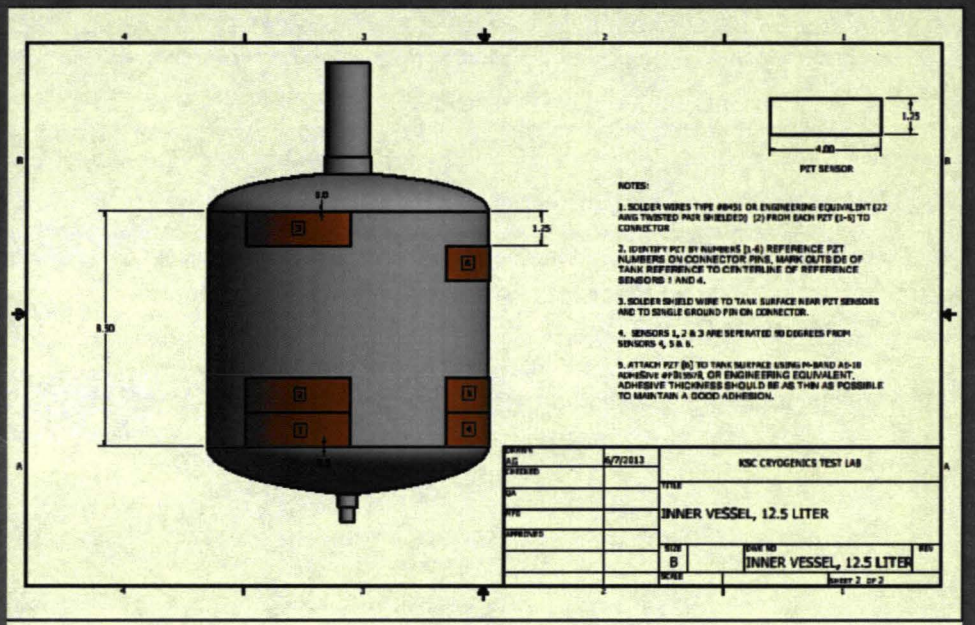
- Fiber optics
- PZT sensors
- Strain gauges

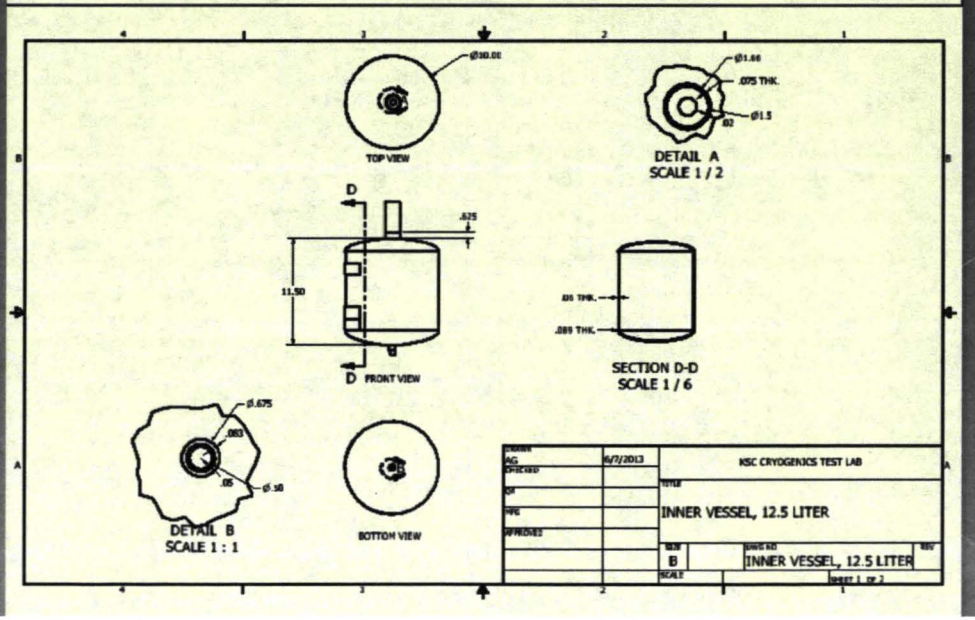




Computer Aided Design

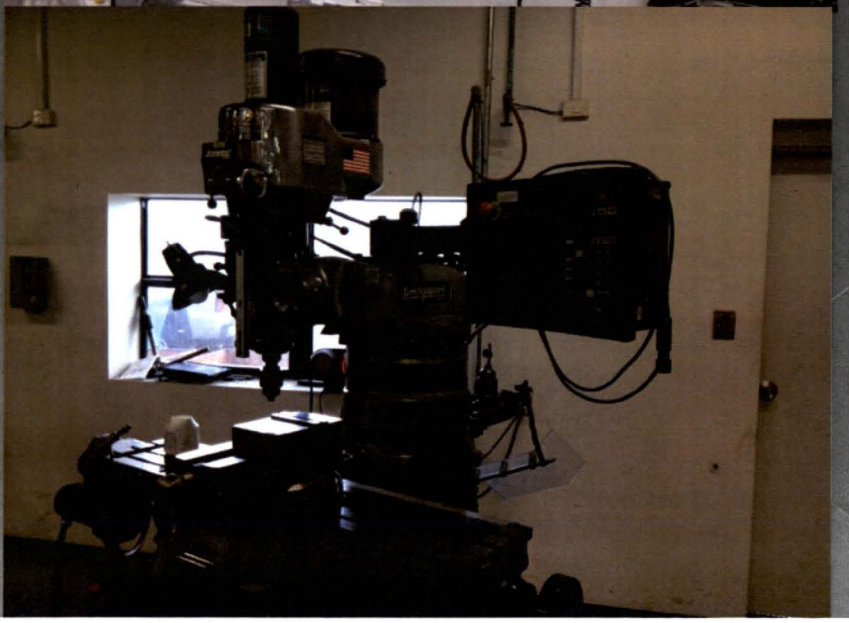
- Technical drawings for manufacturing
- New techniques
- New symbols and terms
- NASA drawing standards





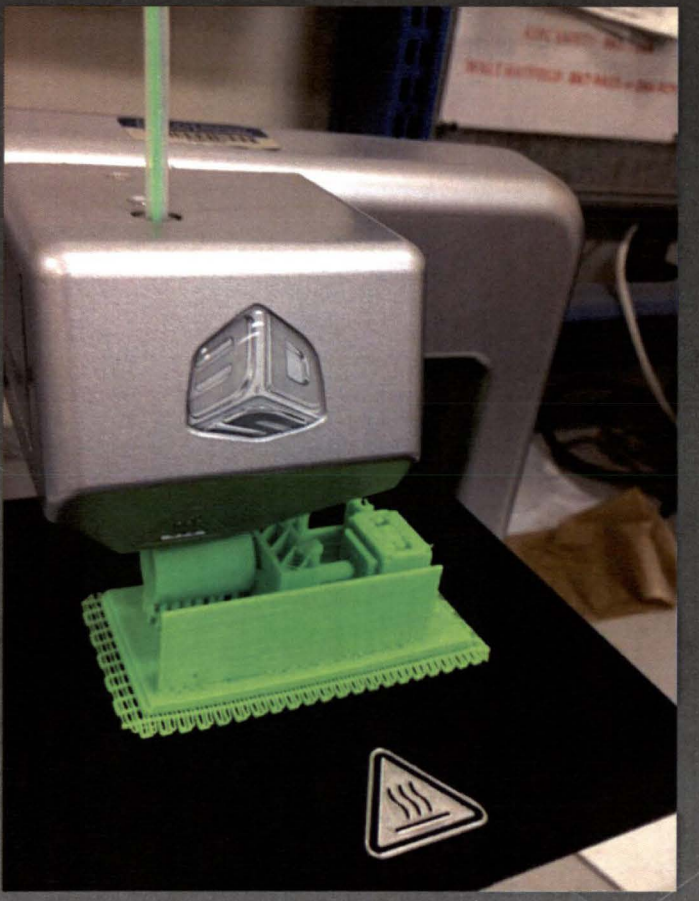
The Prototype Lab

- CNC machines
- EDC machines
- Milling machines
- Water Jet
- Lathes
- Sliding Bandsaw
- 3D printers



3D Printing

- Takes standard 3d drawing format.
- Variety of materials
- Movable Parts
- Rapid prototyping



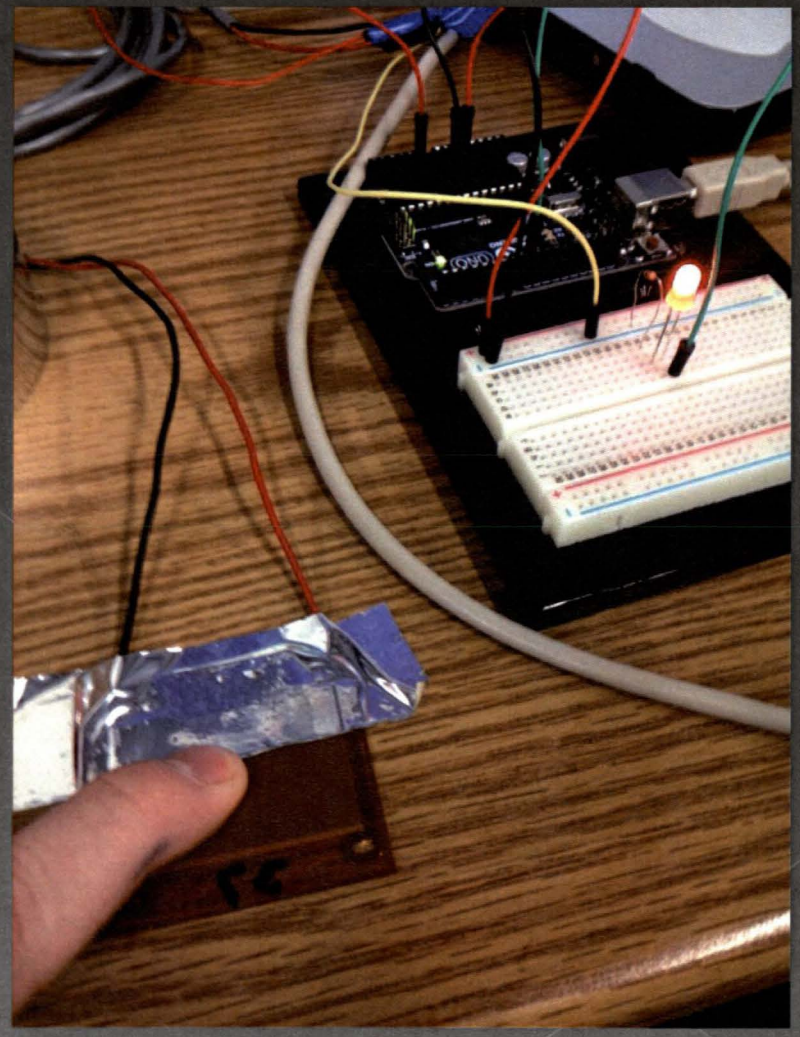
Welding

- Different types of welding processes
- SMAW (stick welding)
- GMAW (MIG welding)
- GTAW (TIG welding)
- Tips and tricks

The Liquid Nitrogen Skid

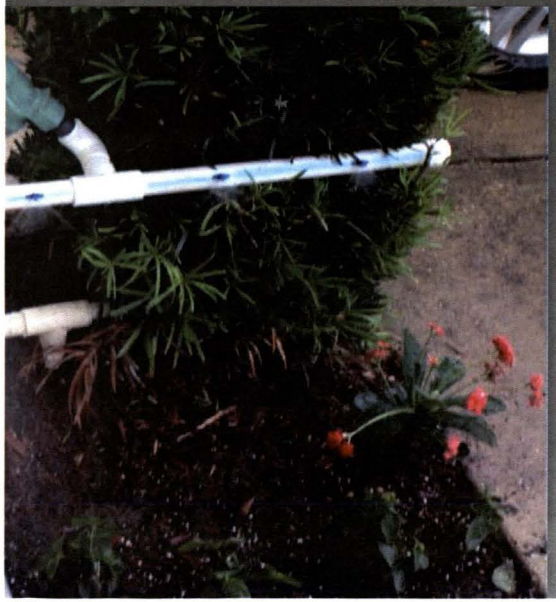
Programming Microcontrollers

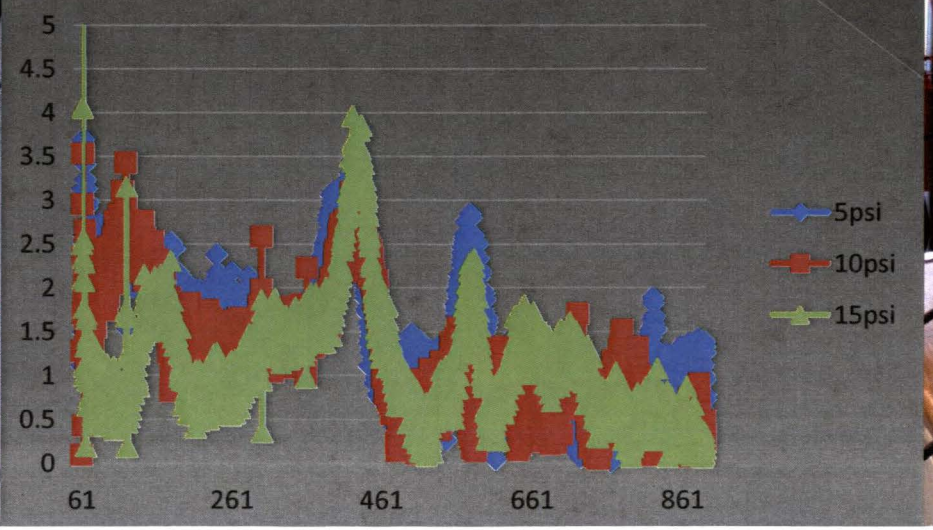
- Integrated circuit chips
- Arduino
- C and C++ programing language.
- 6 sensor inputs
- 14 digital outputs

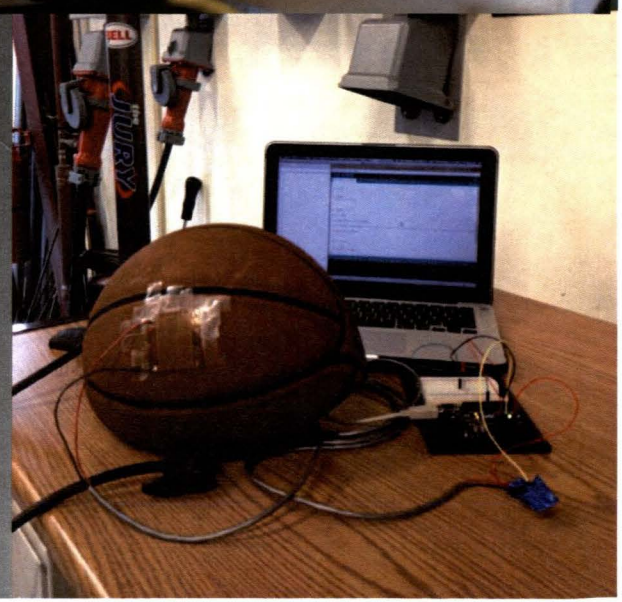


Experiments

- Temperature testing
- Basketball air pressure PZT analysis
- Automatic plant watering system







Thank You